AIRS Infrared Radiance Validation Concept Using Earth Scene Observations

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The Atmospheric Infrared Sounder (AIRS) will fly onboard the NASA Earth Observing Satellite **(EOS)** polar-orbiting Aqua spacecraft. AIRS, a high resolution infrared spectrometer with visible and near-infrared spectral channels, has been designed to provide atmospheric temperature and moisture profiles at least as accurate as those measured by standard radiosondes. Calibration studies of the response of each of the AIRS 4000+ detectors will begin as soon as the spacecraft orbit and instrument have stabilized. These studies are needed to help assess the contribution of instrument measurement errors to the spectral radiance determination. Some of the uncertainties will be determined from measurements of the onboard calibrators. Other sources of measurement uncertainty, such as scan mirror polarization and spectral response functions, require views of Earth at nadir and at oblique viewing angles, in cloud-free conditions.

During early operation of the instrument, the blackbody radiance determination will rely on pre-launch measurements and models of the spectral response functions. During this phase of the operation, we have chosen an approach for initial assessment of the accuracy of the measured radiance that is not dependent on an exact knowledge of the spectral position of the detectors. Radiances will be evaluated in narrow regions that are well removed from spectral line features. There are potentially hundreds of detectors that can be used for this purpose. Our work to date has focused on a subset of these detectors located in atmospheric window regions between 2500-2700 and 800-1200 wavenumbers. Pre-launch thermal-vacuum blackbody calibration results indicate that, using a reasonable cross-section of detectors, it should be possible to extrapolate the performance of a sparse set of detectors to the general state of the instrument calibration.

In this paper we describe some initial results using a simple statistical methodology that compares outgoing radiances in very narrow spectral window regions with sea surface temperature (SST) weekly climatology and the NCEP/ECMWF forecasts. This technique has been tested using global simulation data sets derived from the NCEP Aviation Forecasts. Simulated AIRS TOA radiances are "adjusted" to the surface to account for the spectral dependence of atmospheric continuum absorption and surface emission. The calculated radiances are differenced against the observed SST. This methodology was found to work very well for basic evaluations of instrument performance with an uncertainty of 1 K. Residual cloud contamination and sea surface skin-bulk temperature differences contribute to this level of uncertainty. Because AIRS has very high spectral resolution and atmospheric absorption in some of the window channels is very small (0.1-0.3 K), AIRS has the potential to measure with a precision approaching 0.1 K. We discuss some of the challenges that must be met to enable validation at very high accuracy.